REMARKS

Applicant thanks the Examiner for the attention accorded the present Application in the November 7, 2002 Final Office Action, in which claims 1-35 were pending. In that Action, claims 8-17 were withdrawn from consideration as being drawn to a non-elected invention; claims 1-7 and 18-35 were objected to for minor informalities; claims 1-7, 18-25, 28 and 30-35 were rejected under 35 U.S.C. § 102(b) as being anticipated by Inagaki; claims 26 and 29 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Inagaki; and claim 27 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Inagaki in view of Cheadle.

By the foregoing amendments, claims 1-7 and 18-35 have been amended to more clearly specify the present invention. No new matter has been added, and the amendments are fully supported throughout the specification, as more fully described below.

Claims 1-7 and 18-35 are now currently pending in this Application. Based on the above amendments, Applicants respectfully submit that the rejections to claims 1-7 and 18-35 have been overcome. Reconsideration of this Application is respectfully requested in view of the foregoing amendments and the following remarks.

Claim Objections

Claims 1-7 and 18-35 were objected to for containing minor informalities – i.e., the Examiner stated that "zirconium alloy" should be amended to state that the balance of the composition is zirconium, i.e., "zirconium-based alloy." The claims have been amended so they read "[a] creep resistant zirconium-based alloy ... ."[1] Furthermore, claim 21 has been amended to read "[a] creep resistant zirconium-based alloy comprising ... the balance being substantially zirconium ... ."[2] Applicants submit that these amendments overcome this objection. As such, withdrawal of this objection is respectfully requested.

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1 Applicant's spec., claims 1-7 and 18-35.
2 Applicant's spec., claim 21.

35 U.S.C. § 102 rejection

Claims 1-7, 18-25, 28 and 30-35 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Inagaki et al. Applicants respectfully disagree with the Examiner's conclusion and submit that the present invention is not anticipated, nor even suggested, by Inagaki.

As presently claimed in Applicant's independent claims, Applicants' invention comprises "[a] creep resistant zirconium-based alloy for use in nuclear fuel cladding, wherein the zirconium-based alloy comprises a coarse grained lath alpha microstructure, and wherein the zirconium-based alloy comprises an annular layer in the cladding."[3] These amendments are supported by Applicant's specification at page 7, lines 4-11, and in Figure 1A, among other places.

In contrast, Inagaki does not disclose a zirconium-based alloy for use in an annularly layered fuel cladding. Inagaki's invention comprises "a nuclear fuel cladding tube made of a zirconium-based alloy."[4] Inagaki mentions only that "the nuclear fuel cladding tube of the invention is made of the zirconium-based alloy of the invention,"[5] and never mentions that these tubes could comprise annular layers of materials as claimed in Applicants' invention. Therefore, Inagaki does not anticipate, nor even suggest, a creep resistant zirconium-based alloy for use in an annularly layered fuel cladding, as recited in independent claims 1, 21 and 30 of Applicant's invention.

As claims 2-7 and 18-20 depend from claim 1, claims 22-25 and 28 depend from claim 21, and claims 31-35 depend from claim 30, the discussion above applies to these claims as well. Further, these claims each include separate novel features. Thus, Applicant respectfully requests allowance of pending claims 1-7, 18-25, 28 and 30-35.

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[3] Applicant's spec., independent claim 1. *See also* Applicant's spec., independent claims 21 and 30.
[4] Inagaki, independent claims 1, 3, 5 and 7.
[5] Inagaki, col. 5, lines 7-12.

35 U.S.C. § 103(a) rejections

1. Rejection of claims 26 and 29

Claims 26 and 29 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Inagaki et al. Applicant respectfully disagrees with the Examiner's conclusion and submits that the present invention is not obvious in view of, nor is it even suggested by, Inagaki.

As presently claimed in Applicant's independent claims, and as previously discussed above, Applicant's invention comprises a creep resistant zirconium-based alloy for use in an annularly layered fuel cladding.

In contrast, and as also previously discussed above, Inagaki does not disclose a zirconium-based alloy for use in an annularly layered fuel cladding. Inagaki discloses "a nuclear fuel cladding tube made of a zirconium-based alloy."[6] Thus, Inagaki does not disclose, nor even suggest, a creep resistant zirconium-based alloy for use in an annularly layered fuel cladding, as recited in independent claim 21 of Applicant's invention.

Based on the above arguments and amendments, Applicants respectfully submit that independent claim 21 of the present invention is patentably distinguished from Inagaki. As claims 26 and 29 depend from claim 21, the discussion above applies to these claims as well. Further, these claims each include separate novel features. Thus, Applicant respectfully requests allowance of pending claims 26 and 29.

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[6] Inagaki, independent claims 1, 3, 5 and 7.

2. Rejection of claim 27

Claim 27 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Inagaki et al in view of Cheadle. Applicant respectfully disagrees with the Examiner's conclusion and submits that the present invention is not obvious in view of, nor is it even suggested by, Inagaki and/or Cheadle.

As presently claimed in Applicant's independent claims, and as previously discussed above, Applicant's invention comprises a creep resistant zirconium-based alloy for use in an annularly layered fuel cladding.

In contrast, and as also previously discussed above, Inagaki does not disclose a zirconium-based alloy for use in an annularly layered fuel cladding. Inagaki discloses "a nuclear fuel cladding tube made of a zirconium-based alloy."[7] Thus, Inagaki does not disclose, nor even suggest, a creep resistant zirconium-based alloy for use in an annularly layered fuel cladding, as recited in independent claim 21 of Applicant's invention.

Cheadle fails to cure the deficiencies of Inagaki. Cheadle does not disclose a zirconium-based alloy for use in an annularly layered fuel cladding either. Cheadle discloses "zirconium alloy tubes especially for use in nuclear applications.[8] Furthermore, Cheadle discloses that these tubes are extruded,[9] and never mentions that these tubes could comprise annular layers of materials as claimed in Applicants' invention. Thus, Cheadle does not disclose, nor even suggest, a creep resistant zirconium-based alloy for use in an annularly layered fuel cladding, as recited in independent claim 21 of Applicant's invention.

Based on the above arguments and amendments, Applicant respectfully submits that independent claim 21 of the present invention is patentably distinguished from Inagaki and Cheadle. As claim 27 depends from claim 21, the discussion above applies to this claim as well. Further, this claim includes separate novel features. Thus, Applicant respectfully requests allowance of pending claim 27.

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7 Inagaki, independent claims 1, 3, 5 and 7.
8 Cheadle, col. 1, lines 5-6.
9 Cheadle, col. 1, lines 8-38; col. 3, lines 26-47; and claim 1.

CONCLUSION

Applicants respectfully submit that the amendments to the claims successfully traverse the rejections and objections given by the Examiner in the Final Office Action. For the above reasons, it is respectfully submitted that the claims now pending patentably distinguish the present invention from the cited references. Allowance of pending claims 1-7 and 18-35 is therefore respectfully requested.

As this reply is being timely filed within the 3 month time period, Applicant believes that there is no fee due for this response. If this is incorrect however, the Commissioner is authorized to charge any additional fees that may be due, or credit any overpayment, to **Deposit Account No. 04-1448**.

Should the Examiner have any questions, or determine that any further action is necessary to place this Application into better form for allowance, the Examiner is encouraged to telephone the undersigned representative at the number listed below.

Respectfully submitted,

Date: 1/7/03

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

Amendments in the Specification:

In accordance with 37 C.F.R. § 1.121(b), the following replacement paragraphs show all of the changes made by the foregoing amendments relative to the previous versions of the paragraphs. Material added is shown underlined, material deleted is shown in [brackets].

Please amend the fourth full paragraph on page 8 as follows:

Two plates of Zircaloy-2 were compared. Plate A was cold rolled 51 % from an as-hot rolled Zircaloy-2 plate nominally one inch thick. Plate B was cold rolled 36% from a second one inch thick plate which was beta heat treated and quenched before cold rolling. Following cold rolling, both plates were given a 3 hr heat treatment in Ar gas at 620°C. Plate A had a uniform fine recrystallized grain structure. Plate B had a coarse grained lath alpha-zirconium microstructure in part of the plate thickness and a recrystallized grain structure in the remainder. Zircaloy-2 has a low volume fraction of second phase particles that contribute to the plastic deformation [behaviour] behavior and corrosion resistance of the alloy. The mean second phase particle diameter of Plate A was 0.20μm. The mean second phase particle diameter of Plate B was 0.075μm.

Amendments in the Claims:

In accordance with 37 C.F.R. § 1.121(c)(1), the following replacement claims show all of the changes made by the foregoing amendments relative to the previous versions of the claims. Material added is shown underlined, material deleted is shown in [brackets].

1. (Amended) A creep resistant [zirconium] zirconium-based alloy for use in nuclear fuel cladding, wherein the zirconium-based alloy comprises [comprising] a coarse grained lath alpha microstructure[.], and wherein the zirconium-based alloy comprises an annular layer in the cladding.

2. (Twice Amended) The [zirconium] zirconium-based alloy as claimed in claim 1 wherein the microstructure comprises second phase precipitates.

3. (Twice Amended) The [zirconium] zirconium-based alloy as claimed in claim 2 wherein the second phase precipitates have a diameter less than about 0.15μm.

4. (Amended) The [zirconium] zirconium-based alloy as claimed in claim 3 wherein the microstructure is partially recrystallized.

5. (Amended) The [zirconium] zirconium-based alloy as claimed in claim 4 wherein the microstructure is less than 50% recrystallized.

6. (Twice Amended) The [zirconium] zirconium-based alloy as claimed in claim 1 wherein the microstructure has an acicular structure comprising a lath spacing within the range from about 0.5μm to about 3.0μm.

7. (Twice Amended) The [zirconium] zirconium-based alloy as claimed in claim 5 wherein the microstructure is an acicular structure and comprises a lath spacing within the range from about 0.5μm to about 3.0μm.

18. (Amended) The [zirconium] zirconium-based alloy as claimed in claim 2 wherein the second phase precipitates have a diameter less than about 0.10μm.

19. (Amended) The [zirconium] zirconium-based alloy as claimed in claim 2 wherein the second phase precipitates have a mean particle diameter of about 0.075μm.

20. (Amended) The [zirconium] zirconium-based alloy as claimed in claim 2 wherein the second phase precipitates comprise at least one of Fe and Cr.

21. (Amended) A creep resistant [zirconium] zirconium-based alloy for use in nuclear fuel cladding, said alloy comprising a coarse grained lath alpha microstructure, said alloy comprising approximately 1.2-1.7 weight percent Sn, approximately 0.13 to less than 0.20 weight percent Fe, approximately 0.06-0.15 weight percent Cr, approximately 0.05-0.08 weight percent Ni, and the balance being substantially [Zn;] zirconium, said alloy having been subjected to a predetermined treatment[.], and said alloy comprising an annular layer in said cladding.

22. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 21, wherein the predetermined treatment comprises:

beta heat treating a [zirconium] zirconium-based alloy to form a first intermediate;

fast quenching the first intermediate to form a second intermediate;

cold working the second intermediate to form a third intermediate; and

annealing the third intermediate to effect partial recrystallization of the microstructure.

23. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 22, wherein the cold working step further comprises cold working the second intermediate within the range from about 30% to about 40% to form the third intermediate.

24. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 22, wherein the cold working step further comprises cold working the second intermediate about 36% to form the third intermediate.

25. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 22, wherein the beta heat treating step occurs at a temperature above about 965°C.

26. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 22, wherein the beta heat treating step has a duration of from about 1 second to about 10 seconds.

27. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 22, wherein the fast quenching step is conducted at a cooling rate within the range from about 20°C/second to about 200°C/second.

28. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 22, wherein the annealing step is conducted within the temperature range of from about 570°C to about 640°C.

29. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 22, wherein the annealing step is conducted at about 620°C for about 3 hours.

30. (Amended) A creep resistant [zirconium] zirconium-based alloy for use in nuclear fuel cladding, said alloy comprising a coarse grained lath alpha microstructure comprising second phase precipitates, wherein the microstructure of the alloy is partially recrystallized after being subjected to a treatment comprising beta heat treating the alloy to form a first intermediate, fast quenching the first intermediate to form a second intermediate, cold working the second intermediate to form a third intermediate[;], and then annealing the third intermediate to effect partial recrystallization of the microstructure[.], wherein the alloy comprises an annular layer in the cladding.

31. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 30, wherein the second phase precipitates have a diameter less than about 0.15μm.

32. (Amended) The [zirconium] creep resistant zirconium-based alloy as claimed in claim 30, wherein the second phase precipitates have a mean particle diameter of about 0.075μm.

33. (Amended) The [zirconium] creep resistant zirconium-based alloy as claimed in claim 30, wherein the second phase precipitates comprise at least one of Fe and Cr.

34. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 30, wherein the microstructure is less than 50% recrystallized.

35. (Amended) The creep resistant [zirconium] zirconium-based alloy of claim 30, wherein the microstructure has a acicular structure comprising a lath spacing within the range from about 0.5μm to about 3.0μm.